



ELECTRIC POWER  
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## Infrastructure for Plug-In Vehicles

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# The Electric Power Research Institute

RD&D consortium for the electricity industry founded in 1973

- Independent, unbiased, tax-exempt collaborative research organization
- 460 participants in over 40 countries
- Major offices in Palo Alto, CA; Charlotte, NC and Knoxville, TN



# Overview

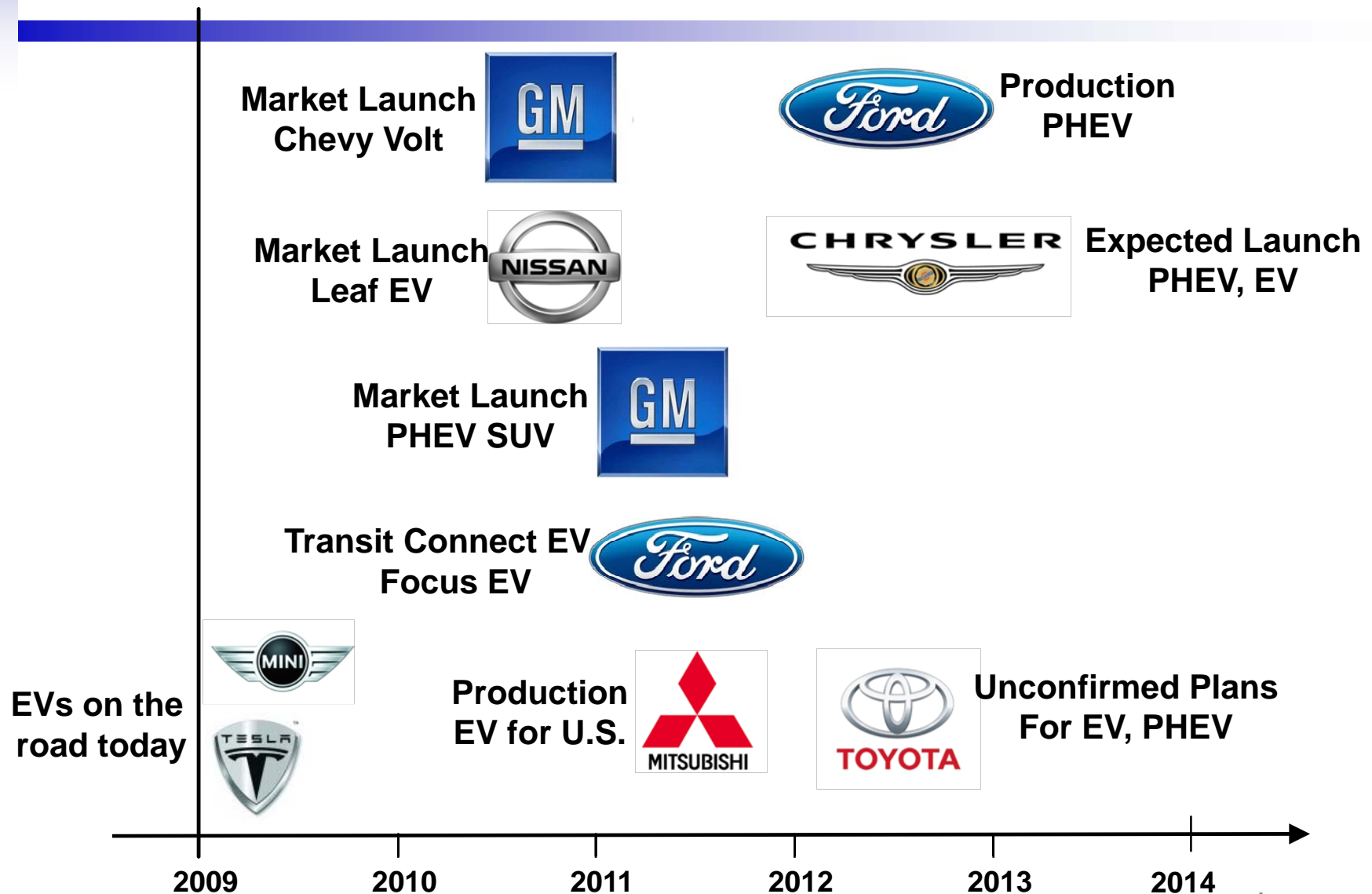
## Tremendous global diversity in EV technologies

- PHEVs, EVs, EREVs
- Building a near-term vehicle population is critical
- Grid is ready
- PEVs have high societal value
- 'Smart Charging' is highly beneficial
- Charging infrastructure requires careful planning
- Close collaboration between auto and utility industries



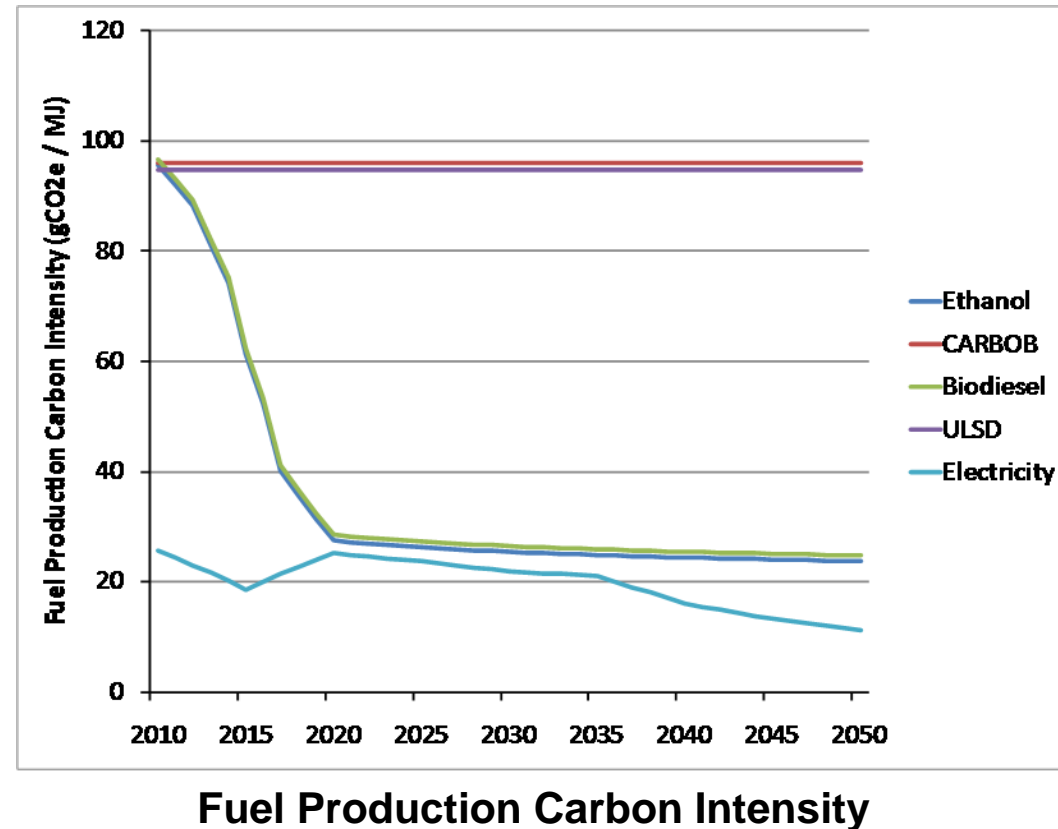
# Major Automaker Production Plans

## Current Status



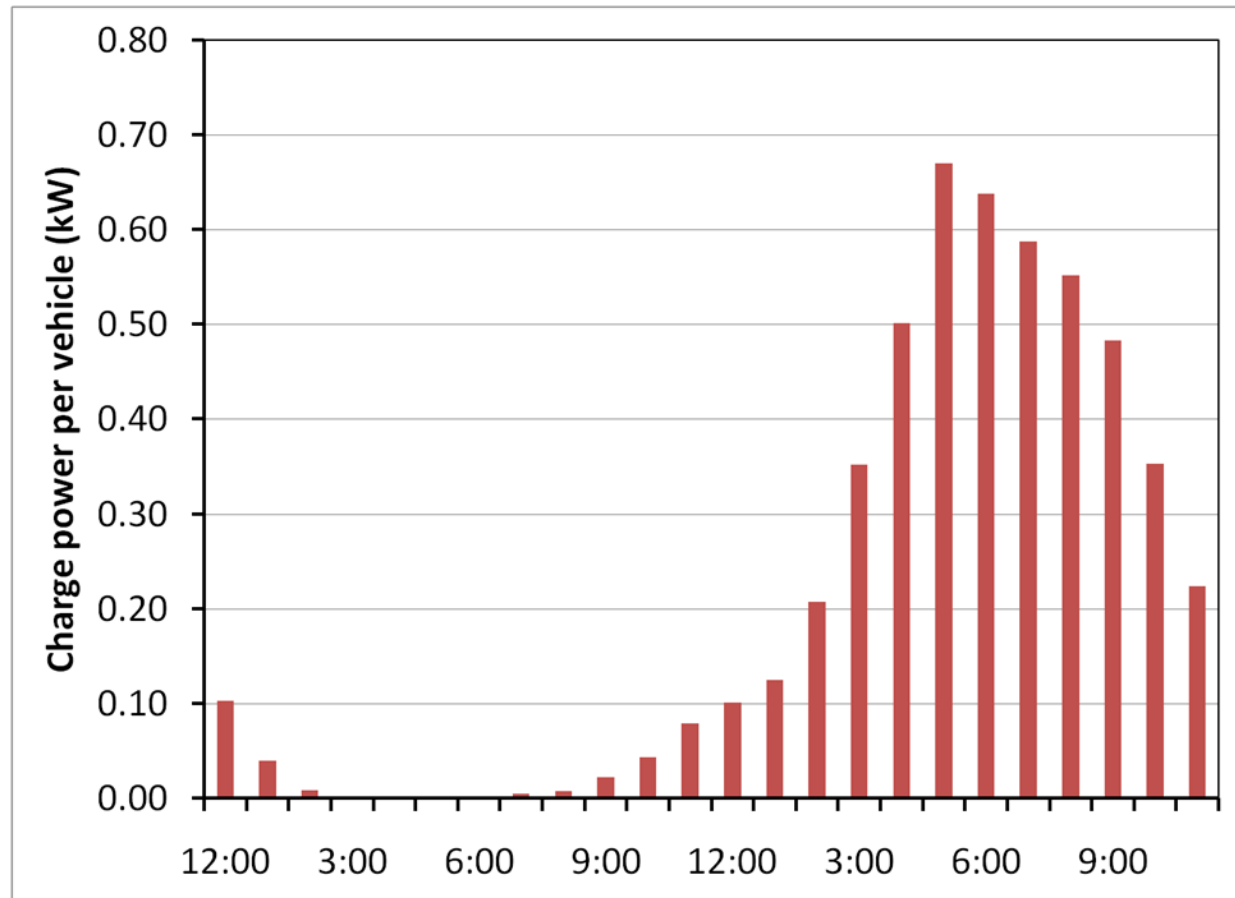
# Electricity as a Low Carbon Fuel in CA

- Marginal electricity supply is low GHG for ET
- Vehicle penetration is dominant factor
- EV range, electricity source not as significant



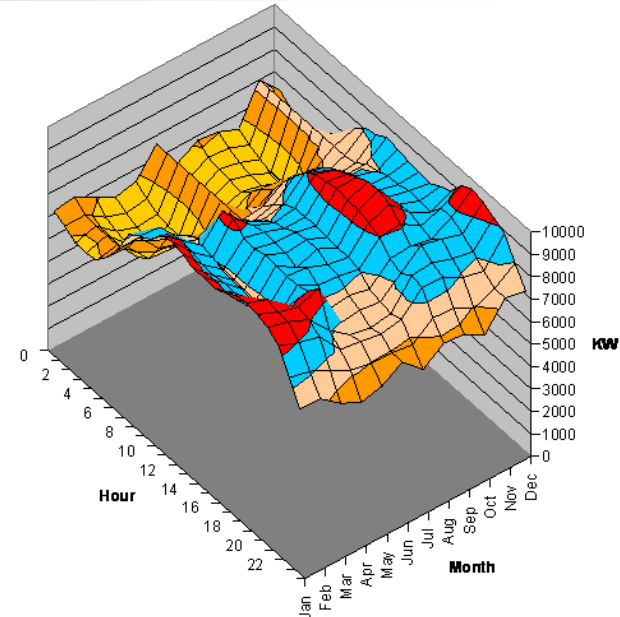
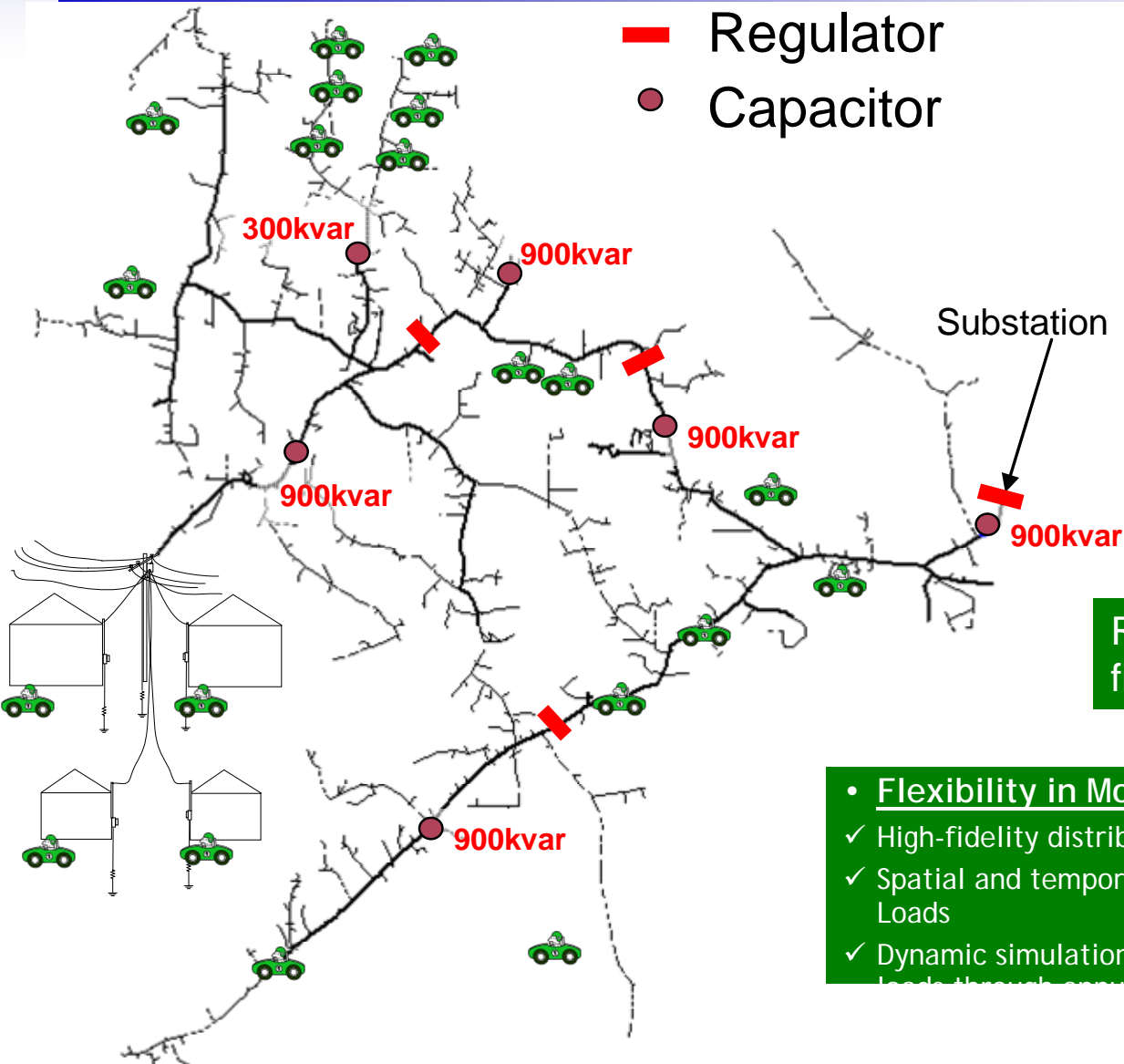


# Power demand for uncontrolled charging



- Vehicle mix is 30% E-REVs, 50% blended PHEVs, 20% EVs
- Average charge power is about 700W per vehicle

# EPRI PHEV Distribution System Impacts – Modeling/Simulation Analytical Framework



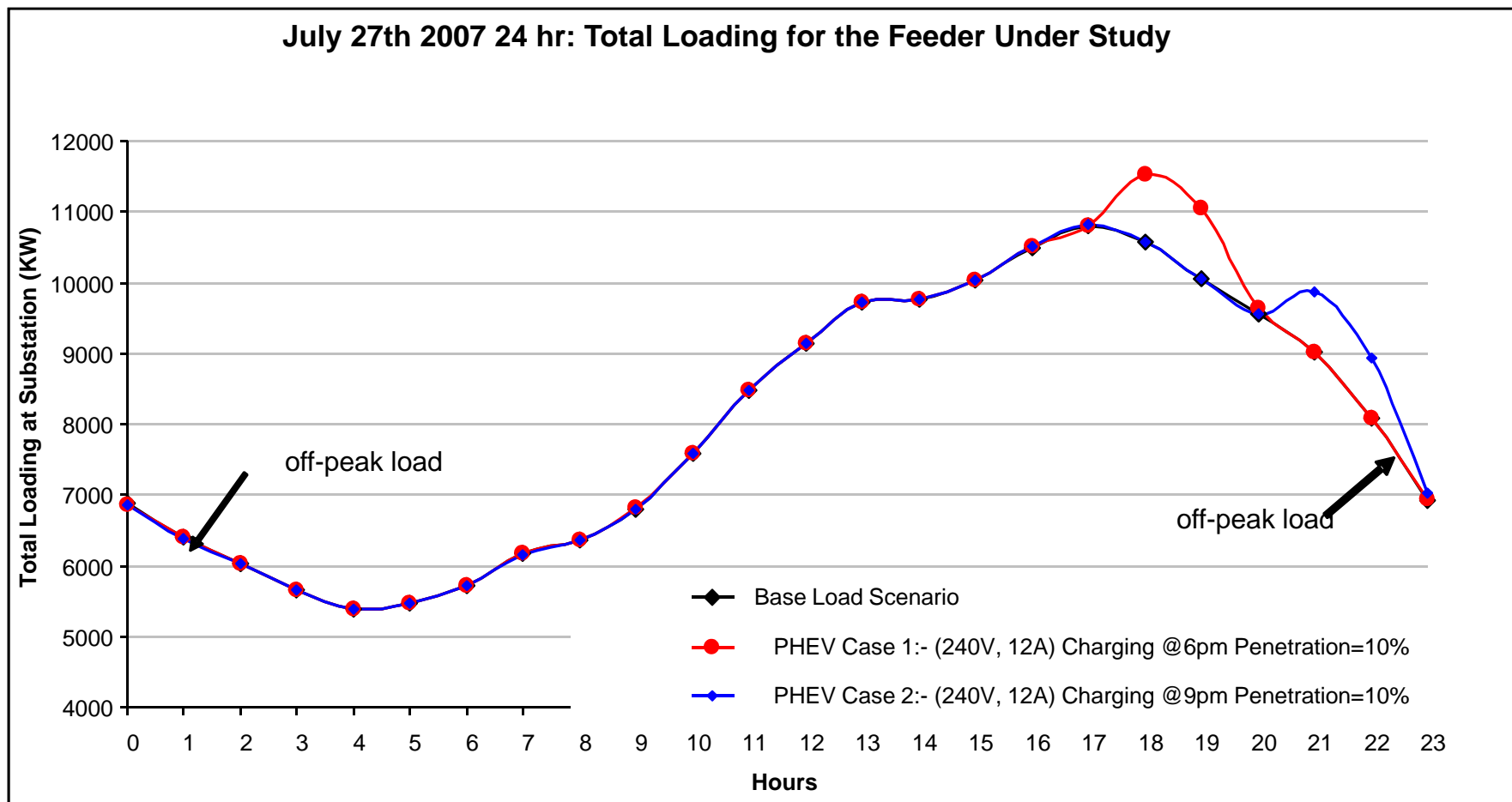
Residential transformers are the first assets significantly impacted

- Flexibility in Model Development

- ✓ High-fidelity distribution feeder models
- ✓ Spatial and temporal variation of circuit loads and PHEV Loads
- ✓ Dynamic simulation of full electrical model serving PHEV loads through annual load levels

# Grid Impacts of EVs are Manageable

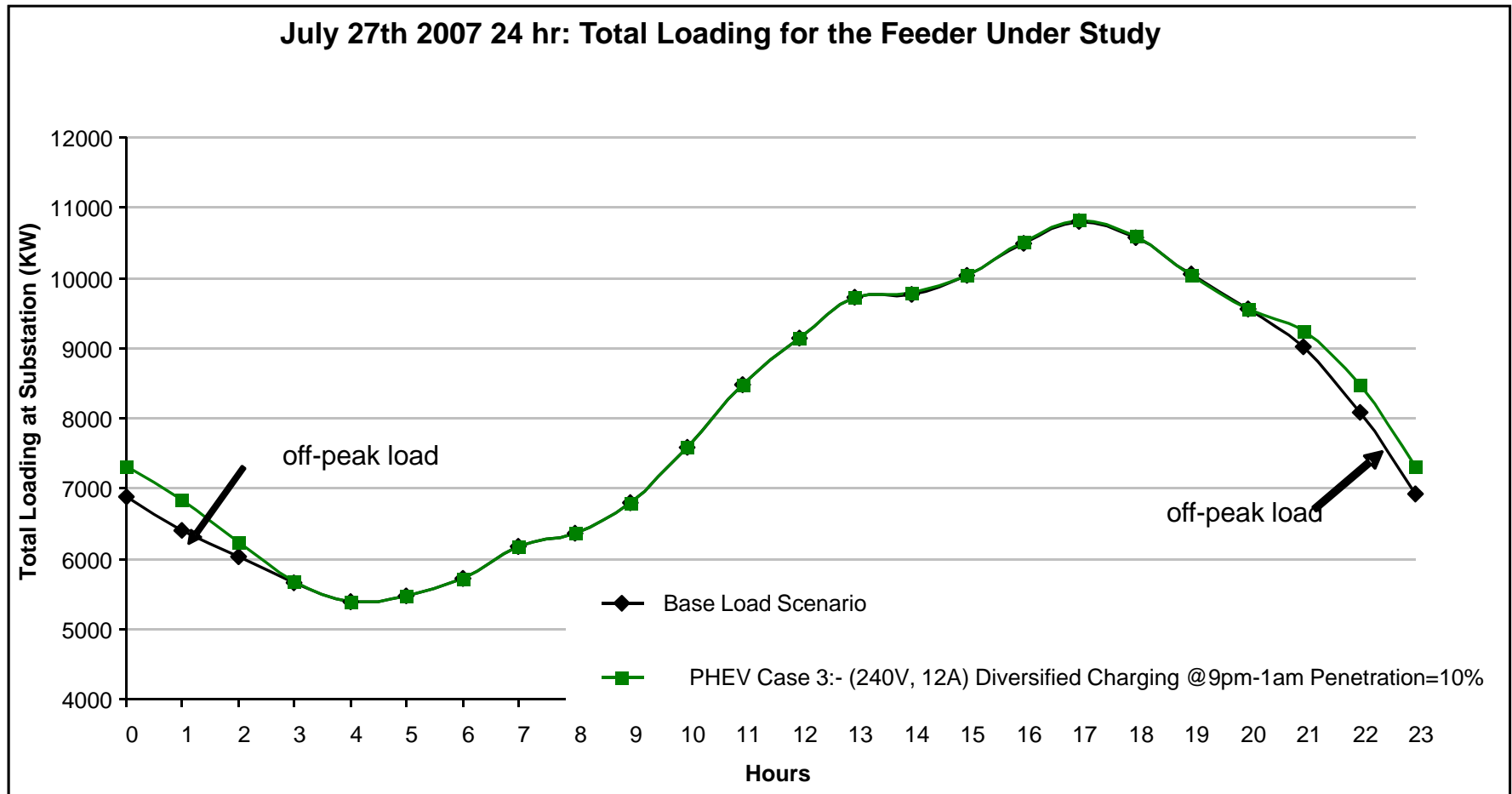
## Smart Charging is a Key Technology to Reduce Impacts



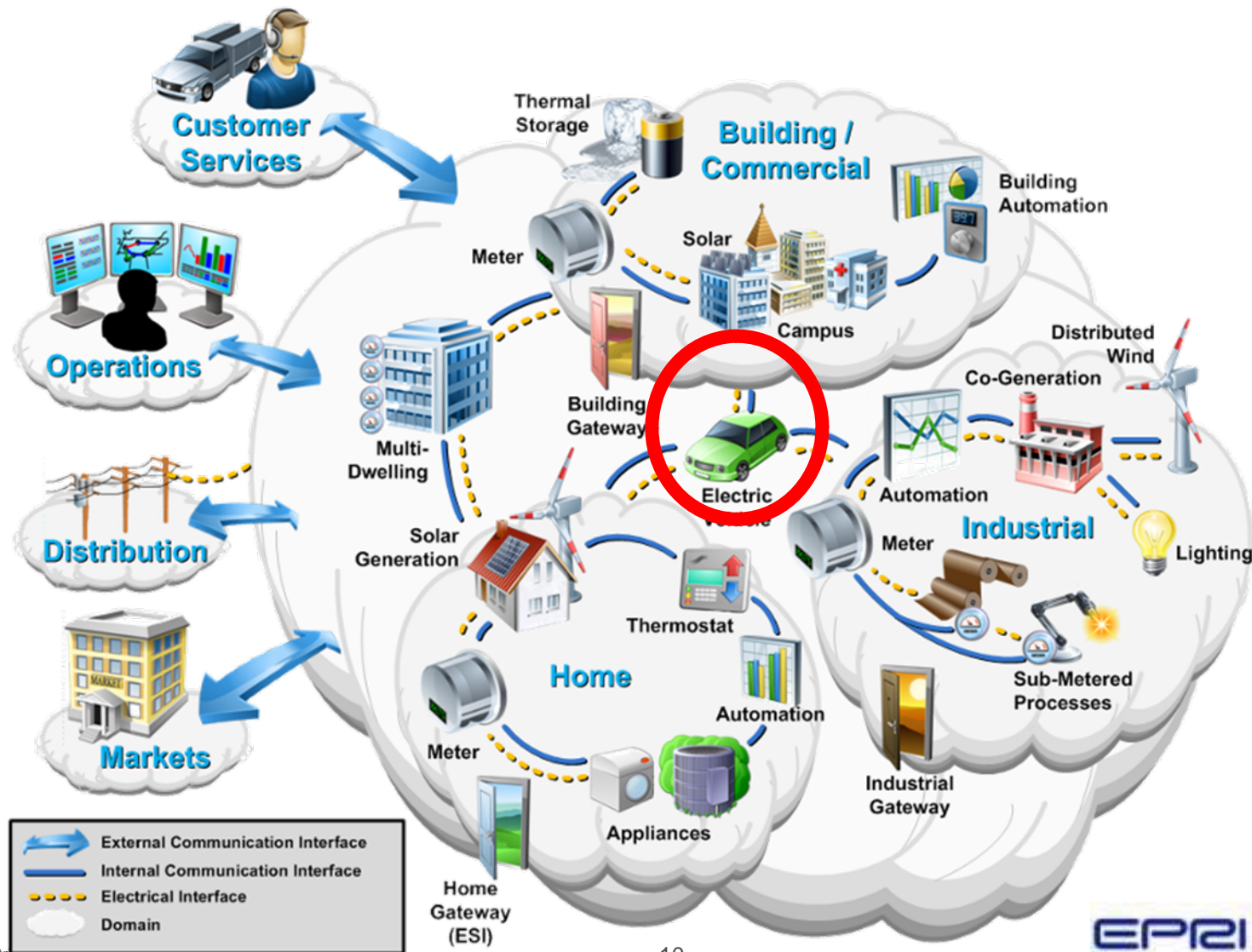


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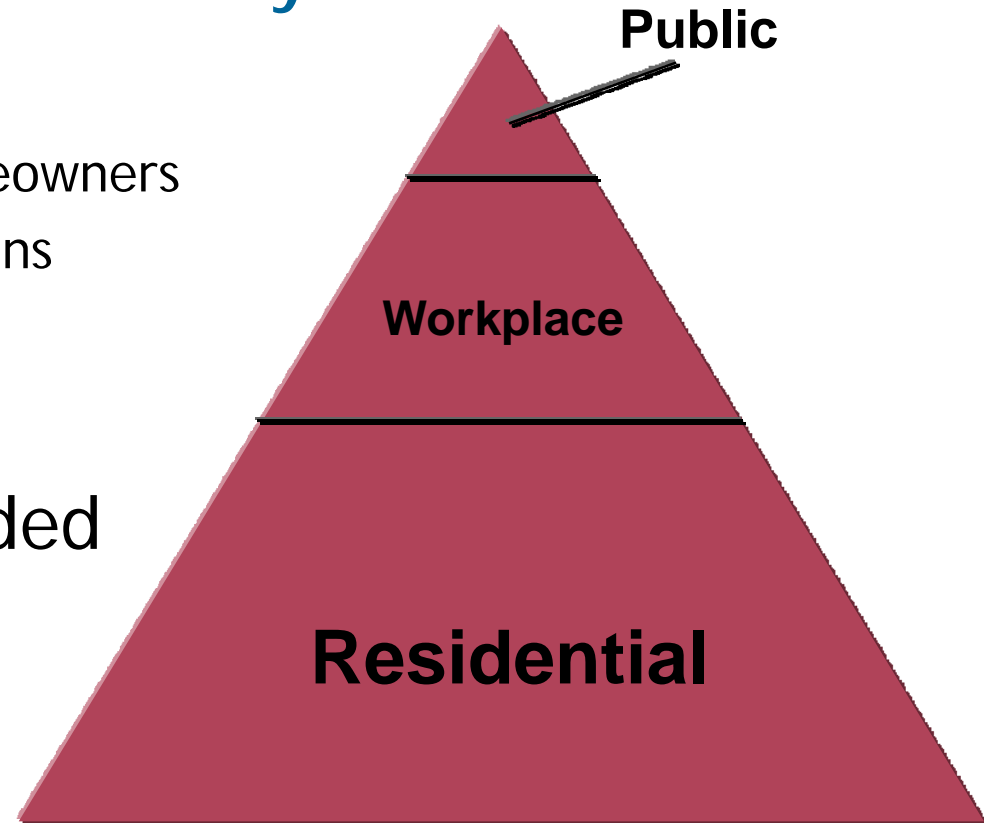
# 'Smart Charging' – Fully Integrating Plug-In Vehicles into Tomorrow's Energy System



# To Electrify Transportation, You Must Get Electricity to the Vehicles

## Build Today's Infrastructure Today

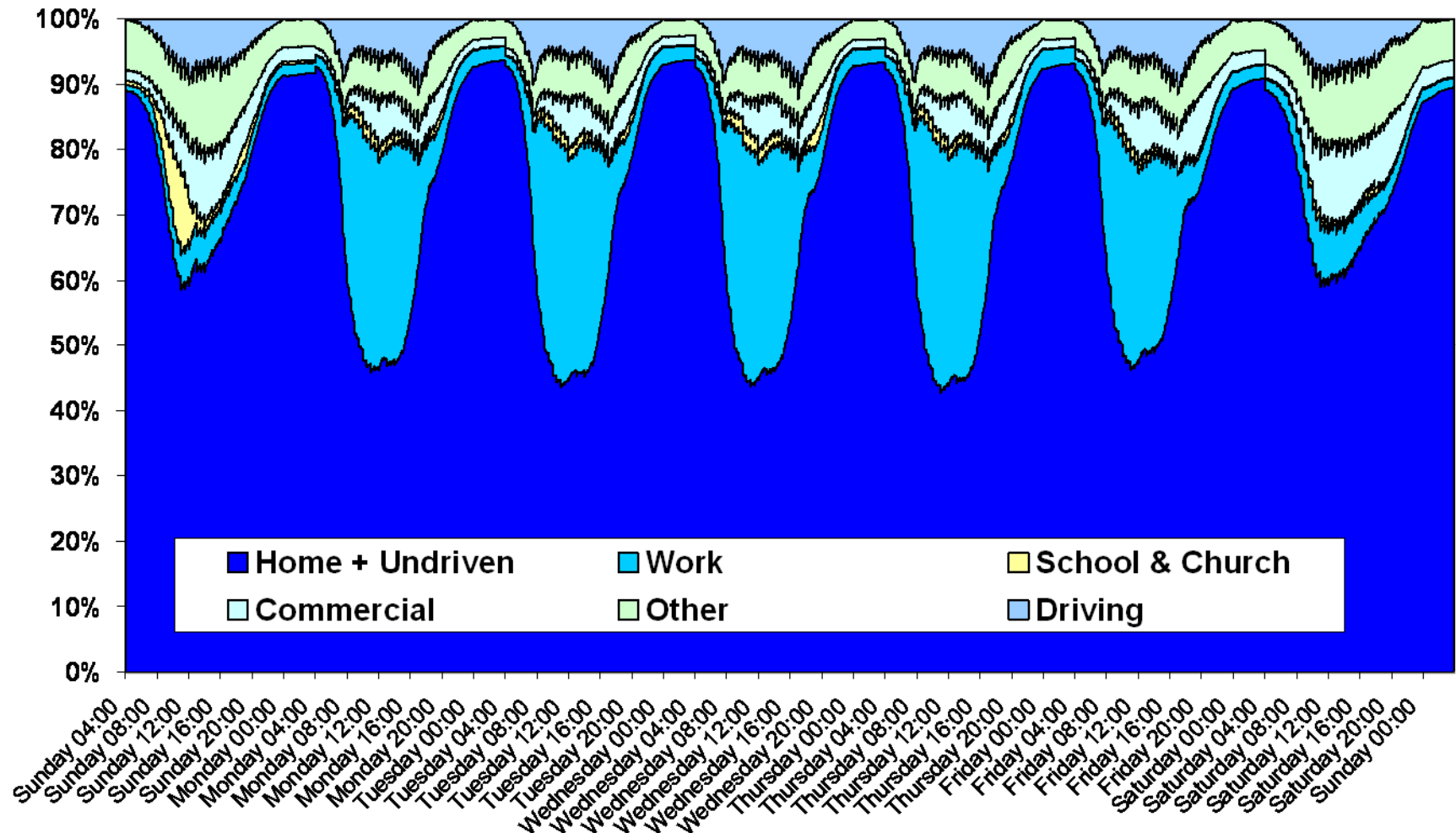
- Focus on Residential
  - Seamless installations for homeowners
  - Permits, electricians, inspections
  - Rates and customer programs
- Workplace
- Public Charging - as needed
  - Retail, private, public spaces
  - Open access
- Know what drivers need
- Know where cars are parked



# Know Where Vehicles Are

## Vehicle Distribution Data – Week Average

Fleet Distribution During Week



# Summary

- The grid can 'handle' it. Electricity is clean and low CO<sub>2</sub>
- The cheapest solution for range anxiety is a plug-in hybrid
  - Forcing one technology to meet all driver requirements is expensive and high-risk
- We do not have enough data to intelligently plan infrastructure deployment
- An intelligent deployment will likely maximize the ET benefit of a given investment
- A variety of ownership/business models are probably necessary
- This should be a careful, data-driven process

# Together...Shaping the Future of Electricity



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